PROFESSOR WILLIAM HAYES

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remembered at , where his portrait place of honour, for toured his domain, by his large Old heep Dog, which master — mirrored nality and appearfor his full-throated of "Land of Hope y" after the port ollege guest nights. retired in 1963 he satisfied that endurlations for the new lege had been laid. ive career was far . He was appointed of Civil Defence for hern Region from 57; and then, retiring Regis to indulge his love of sailing, he he honorary secree local RNLI for 14 e retired finally in 62 years of continuservice.

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st marriage, by which two sons, was diste recently married Roxburgh, a member Professor William
Hayes, FRS,
microbiologist and
molecular geneticist, died
on January 7 aged 80. He
was born in Co Dublin on
January 18, 1913.

BILL HAYES made three major contributions to biology. First, in 1952 he elucidated the mechanism of bacterial sexuality and discovered the sex factor F of Escherichia coli. These discoveries profoundly affected the course of molecular biology. Secondly, he wrote an outstanding book, The Genetics of Bacteria and their Viruses (1964), which influenced generations of scientists. Thirdly, in London and later in Edinburgh, he created particularly open and supportive research environments.

William Hayes was an only child; his father died when he was five and he then lived with his mother and grandmother, and was educated at home. His solitary upbringing may have contributed to the independence of mind that he showed later. After a distinguished undergraduate career at Trinity College, Dublin, he qualified in medicine in 1937 and was then appointed as an assistant lecturer in bacteriology at Trinity.

A refugee from Germany, Professor Hans Sachs, introduced Hayes to serological research. In 1941 Hayes joined the RAMC, serving in India and rising to the rank of major.

Some of his work was on penicillin, which had been made available to the Army. He also first developed his interest in bacterial genetics through his studies on antigenic phase variation in Salmonella. In 1947 he was appointed lecturer in bacteriology at Trinity, but moved to the Postgraduate Medical School at Hammersmith Hospital in 1950.

Bacterial sexuality (conjugation) had first been described by J. Lederberg and F. Tatum in *E.coli* in 1946. In plants and animals, the genetic contributions of the male and female gametes to the zygote are essentially similar, and attempts to understand conjugation by the Lederbergs and their colleague L. Cavalli-Sforza were based on the economical premise that also in bacteria the two mating cells were equal partners. This led to complex explanations



for the actual results. Hayes first showed that the viability of one of the parent strains was not necessary, and interpreted this as evidence for a donor and a recipient.

This work and other observations led him to the revolutionary hypothesis that maleness was determined by a transmissible factor, and showed that this was indeed true: that is, maleness was infectious. This conclusion was arrived at independently by the Lederbergs and Cavalli-Sforza, with whom Hayes freely exchanged views.

Hayes also introduced another novel assumption, namely that only part of the donor's genetic material was transferred: that is, that the genetic contributions of the two partners were unequal. In the words of J. D. Watson, in The Double Helix, "given this assumption, further reasoning was infinitely simpler". In 1952 Hayes attended a small meeting on microbial genetics in Italy.

Again, in the words of Watson, who was present: "Bill's appearance was the sleeper of the three-day meeting; before his talk no one except Cavalli-Sforza knew he existed. As soon as he had finished his unassuming report, however, everyone in the audience knew that a bomb-shell had exploded ..."

As a result, Hayes was invited by M. Delbruck to talk to the 1953 Cold Spring Harbor meeting at which Watson and Crick's structure of DNA was presented, and then to visit the California Institute of Technology. While there he initiated the first experiments on interrupted matings. This fruitful line, partly then in collaboration with F. Jacob and E. Wollman in Paris, led directly to the

proof of unidirectional transfer and the circularity of the genetic map by Jacob and Wollman.

F is the archetype of plasmids, minichromosomes that are ubiquitous in bacterial populations. They confer many properties such as antibiotic resistance, pathogenicity and the ability to degrade man-made pollutants, and have a major role in allowing bacterial populations to evolve rapidly in response to novel situations. They also became essential tools for genetic engineering.

In 1957 the Medical Research Council created a unit around him, and he brought together a group of independently-minded yet interactive staff and graduate students and a stream of visitors. For several years they mounted courses in microbial genetics that ensured that the new ideas were widely propagated. Staff from the unit went to new Chairs in a number of other universities.

Hayes's book made his name known to an even wider audience. Coming so soon after the heroic decade of molecular biology from 1952 to 1962, it became a best-seller. A particular feature of the book was its exceptional lucidity; another was its emphasis on actual experimental design, a hallmark of Hayes's style.

This same desire to communicate to a wider audience was one reason why in 1968 the unit joined Martin Pollock's group from the National Institute for Medical Research, Mill Hill, in Britain's first University Department of Molecular Biology, at Edinburgh. Together with Pollock he again built up an exceptional environment for science.

Hayes had been elected a fellow of the Royal Society in 1964 and president of the Genetical Society in 1971. He also received honorary degrees from Leicester, National University of Ireland, Kent and Trinity, Dublin. However, he was unhappy about his burden of administrative and committee work and in 1974 he moved to the Australian National University as Professor of Genetics, and resumed experimental work, latterly as visiting fellow (1980-1986).

In 1941 Bill Hayes married Honora (Nora) Lee, who nursed him through his final years of illness and who survives him, together with

their son.